Dynamics of Agri-Horti Crops in Hilly Zone of Karnataka : An Economic Analysis

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Abstract

The present study aimed at analyzing the trends in area, production and yield of banana for two different periods *viz.,* Period-I (1995-96 to 2004-05) and Period-II (2005-06 to 2014-15) of Karnataka and India using growth and instability indices. The analysis for two periods was purposefully made to capture the impact of National Horticulture Mission (2005-06) on area, production and productivity of banana. The results revealed that, growth rates of area, production and productivity of banana in India and Karnataka during Period-II was found higher, positive and significant compared to Period-I. The study also focused on shift in cropping pattern between major agriculture and horticultural crops in Hilly Zone of Karnataka for the period from 2001-02 to 2015-16. The results revealed that majority of horticulture crops shown positive trend compared to agriculture crops. Thus, it could be inferred that farmers in Hilly Zone of Karnataka are shifting from traditionally grown less remunerative crops to more remunerative horticultural crops.

Keywords: Growth rates, crop diversification, instability index

Horticulture is the fastest growing sector within agriculture, presently contributes 30 per cent of agricultural GDP (Agarwal *et al.,* 2016). The horticultural sector has also received considerable attention in recent years as it is recognized as a potentially important source of growth, employment generation and foreign exchange earnings (Singh*,* 2015). The horticulture sector encompasses a wide range of crops viz., fruits, vegetables, plantations, ornamental crops, etc. India, with its wide variability of climate and soil, is highly favorable for growing a large number of horticultural crops. Horticulture has emerged as the key instrument of the Indian agricultural development strategy for reduction of poverty, unemployment and malnourishment. The, horticultural-based agricultural diversification in India has been most prominent in the southern states of India (Saraswati *et al*., 2012).Karnataka is one of the progressive states of India with a great potential for development of horticultural crops. The state is blessed with ten agro-climatic regions suitable for growing variety of horticultural crops all-round the year. Of the ten agro-climatic zones, Hilly Zone contribute maximum chunk to fruit production in Karnataka.The agriculture in Karnataka is gradually diversifying towards high-value food commodities especially towards fruits, vegetables, spices, etc. Keeping all these issues in mind, the present study tries to examine the shift in cropping pattern between major agriculture and horticultural crops in Hilly Zone of Karnataka. One of the major landmark reasons to emphasie this sector is being reflected in establishing National Horticulture Mission (NHM) in 2005-06. There by, the study also aimed to explore the impact of establishment of NHM (2005-06) on area, production and productivity of banana in India and Karnataka.

Methodology

For achieving the objectives of the study, secondary data were collected from various published sources of Government of Karnataka and Government of India on area, production and productivity of banana for the country and Karnataka for two time periods *viz.,* Period-I (1995-96 to 2004-05) and Period -II (2005-06 to 2014-15). Data were drawn from indiastat.com and various issues of The Horticultural Statistics at a Glance. Taluk-wise area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops, and other major commercial crops of Shivamogga district which comes under Hilly Zone for 2001-02 to 2014-15 were collected from the Directorate of Economics and Statistics, Bengaluru. For the purpose

of evaluating the objectives of the study, based on the nature and extent of data, the following analytical tools were employed for processing the data to arrive at meaningful results and draw useful conclusions.

1. Compound annual growth rate analysis
2. Instability analysis
3. Crop diversification Indices

1. Compound Annual Growth Rate Analysis

For evaluating the compound annual growth rates of the selected variables cited below. Exponential function of the following form was used.

$$Y_t = A \, B^t \, V_t \qquad … (1)$$

Where,

Y_t = area/production/productivity/other variable under consideration in the year t

A = Intercept indicating Y in the base period (t = 0)

B = 1 + g

t = time period

V_t = Random disturbance term

Equation (1) was converted into linear form by taking logarithmic as follows:

$$\ln Yt = \ln A + t * \ln B + \ln V_t$$

This is of the following form

$$Qt = a + b_t + U_t \quad … (2)$$

Where,

Qt = ln Y

a = ln A

b = ln B

Ut = ln V_t

The parameters 'a' and 'b' were estimated using the Ordinary Least Squares estimation technique. Later, the original 'A' and 'B' parameters in equation (1) were obtained by taking antilogarithms of 'a' and 'b'.

Average annual compound growth rate (%) was calculated as follows:

$$g = (B − 1) * 100$$

2. Instability Analysis

The coefficient of variation was used as a measure to study the variability in the area, production and productivity of banana. The coefficient of variation (CV) was computed using the following formula.

$$CV = (Standard\ Deviation\ /\ Mean)\ X\ 100$$

Linear trend was fitted to the original time series data on area, production and productivity for the two study periods. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend, means coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of determination (R^2). A high degree of instability index signifies violent variations.

Instability Index = (Standard Deviation / Mean) * 100 * $(1- R^2)^{0.5}$

R^2 = Coefficient of determination

3. Crop diversification Indices

Herfindahl Index (HI)

Herfindahl Index (Pant *et al*., 2005) given below is computed by taking sum of squares of acreage proportion of each crop in the total cropped area. Mathematically, the index is given as below

$$HI = \sum_{i=1}^{N} P_i^2$$

Where,

N = total number of crops

P_i = represents area proportion of the ith crop in total cropped area.

This index takes a value one when there is complete concentration and approaches zero when diversification is perfect. Thus the HI is bounded by Zero and one. One minus HI will gives the Simpsons index of diversification (SI) and similar to HI the range of SI range between zero to one but interpretation is quite opposite to HI *i.e.*, Value of SID closer to zero indicates near to the specialization and value closer to one indicates diversification .

Composite Entropy Index (CEI)

This index possesses all desirable properties of above mentioned indices and is used to compare diversification across situations having different and

large number of crops since it gives due weightage to the number of crops. The formula of C.E.I. is given by:

$$C.E.I = \left(\sum_{i=1}^{N} P_i^* \log P_i \right) x \left(1 - \left(\frac{1}{N} \right) \right)$$

The value of Composite Entropy Index increases with the decrease in concentration and rises with the number of crops. The value of C.E.I. ranges between zero to one.

RESULTS AND DISCUSSION

Growth performance of Banana in Karnataka and India

Growth in area, production and productivity of banana in India and Karnataka was estimated by using the exponential function. The study period (1995-96 to 2014-15) was divided into two sub periods viz, Period – I (1995-96 to 2004-05) and Period-II (2005-06 to 2014-15) due to significant shift in area, production and productivity of Horticultural crops in general and banana in particular. This break in two study periods was synchronized with introduction of National Horticulture Mission (NHM) during 2005-06 by Government of India, and has contributed for the increase in area, production and productivity of banana in India and Karnataka.

The results presented in Table-I on compound annual growth rates (CAGR) for Karnataka and India revealed that, the growth rates of area during all the three study periods Period I (1995-96 to 2004-05), Period II (2005-06 to 2014-15) and Overall Period (1995-96 to 2014-15) for Karnataka were found positive and significant (1.86%, 5.98% and 4.28 %, respectively). The respective figures for area of banana in India's 1.59, 4.64 and 3.40 per cent and were also found significant. The banana production in Karnataka and India also showed significant growth during the Period-II and Overall Period, however the growth rate of banana production during the period-I was not significant. Inspite of significant area increase under banana during pre-NHM period, the growth rate of banana production was not significant due to non-significant growth rate of banana productivity for both Karnataka and India. The findings of Kumar and Chandrashekar (2015) also confirmed highly and significant positive growth rates for major horticultural crops in Karnataka.

Instability analysis of Banana in Karnataka and India

The results on instability analysis of banana showed a moderate degree of instability during Period-I (8.22%) and relatively high degree of

TABLE I

Growth rates in area, production and productivity of Banana in Karnataka and India

Karnataka			Karnataka		
Period	CAGR (%)		Period	CAGR (%)	
Area (000 ha)					
Period-I (1995-96 to 2004-05)	1.86	*	Period-I (1995-96 to 2004-05)	1.59	*
Period-II (2005-06 to 2014-15)	5.98	**	Period-II (2005-06 to 2014-15)	4.64	**
Overall period (1995-96 to 2014-15)	4.28	**	Overall period (1995-96 to 2014-15)	3.40	**
Production (000 tonne)					
Period-I (1995-96 to 2004-05)	2.71		Period-I (1995-96 to 2004-05)	2.28	
Period-II (2005-06 to 2014-15)	9.86	**	Period-II (2005-06 to 2014-15)	7.84	**
Overall period (1995-96 to 2014-15)	6.17	**	Overall period (1995-96 to 2014-15)	5.86	**
Productivity (kg/ha)					
Period-I (1995-96 to 2004-05)	0.85		Period-I (1995-96 to 2004-05)	0.69	
Period-II (2005-06 to 2014-15)	3.82	**	Period-II (2005-06 to 2014-15)	2.56	**
Overall period (1995-96 to 2014-15)	1.89	*	Overall period (1995-96 to 2014-15)	2.06	*

instability during Period-II in Karnataka (11.74%). With respect to banana area in the country, Period – II (2000-01 to 2013-14) showed high degree of instability (15.07%) compared to Period-I (1995-96 to 2004-05) where it was only 5.18 per cent. The results on production of banana in Karnataka represent relatively high degree of instability during Period II (2005-06 to 2014-15) and Overall Period (1995-96 to 2014-15) with instability indices of 26.09 and 32.78 per cent, respectively compared to India (Table II).

The instability analysis on productivity of banana in Karnataka also indicated comparatively high degree of instability for Period - II (2005-06 to 2014-15)and overall period (1995-96 to 2014-15) with respective indices values of 35.75 and 31.29 per cent compared to India. Similar findings were reported by Singh *et al*. (2014), on high degree of instability for horticultural crops in Karnataka.

Growth rates of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)

The results on growth rates for area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops and other major commercial crops of Shivamogga district of Hilly Zone for the period from 2001-02 to 2015-16 are presented in the Table III. The analysis

was carried out using exponential function. The estimated growth results revealed that Hosanagara taluk showed the highest positive and significant growth in area under rubber (9.52%) followed by Areacanut (7.23 %), total spices (6.02%) and banana (3.90%). On the other hand the highest negative and significant growth rate of area was observed for total pulses (-27.85%) followed by total vegetables (-2.87%) and paddy (-0.77%). The results on Soraba taluk showed that, the highest positive and significant growth in area was noticed for ginger (12.87%) followed by Rubber (8.41 %), areacanut (6.91%), banana (7.72%) and total spices (5.91%). While, the highest negative and significant growth rate was observed for total oilseeds (-15.24%) followed by total vegetables (-14.29%) and total pulses (-6.8/0%).

In Thirthahalli taluk area under banana (8.43%) showed a positive and significant growth followed by rubber (7.21%), arecanut (4.02 %) and total spices (3.69%).While declining trend was observed for area under total pulses (-14.24%), total vegetables (-10.29%) and coconut (-4.31%). Area under banana (10.56%) showed a significant growth rate followed by rubber (7.84%), total fruits (4.32%) and ginger (4.19%) in Sagar taluk. The growth performance of area under different crops for the Shivamogga district

TABLE II

Instability indices for area, production and productivity of banana in Karnataka and India

Karnataka	Instability Index	India	Instability Index
Area			
Period-I (1995-96 to 2004-05)	8.22	Period-I (1995-96 to 2004-05)	5.18
Period-II (2005-06 to 2014-15)	11.74	Period-II (2005-06 to 2014-15)	15.07
Overall period (1995-96 to 2014-15)	9.31	Overall period (1995-96 to 2014-15)	14.50
Production			
Period-I (1995-96 to 2004-05)	6.94	Period-I (1995-96 to 2004-05)	14.58
Period-II (2005-06 to 2014-15)	26.09	Period-II(2005-06 to 2014-15)	18.06
Overall period (1995-96 to 2014-15)	32.78	Overall period (1995-96 to 2014-15)	21.59
Productivity			
Period-I (1995-96 to 2004-05)	18.82	Period-I (1995-96 to 2004-05)	5.84
Period-II (2005-06 to 2014-15)	35.57	Period-II (2005-06 to 2014-15)	11.60
Overall period (1995-96 to 2014-15)	31.29	Overall period (1995-96 to 2014-15)	9.89

TABLE III

Growth rates of major crops in hilly zone of Karnataka (2001-02 to 2015-16)

Shivamogga District

Crop	Hosanagara		Soraba		Thirthalli		Sagar		Shivamogga District	
	Mean Area (in ha)	CAGR (%)	Mean Area (in ha)	CAGR (%)	Mean Area (in ha)	CAGR (%)	Mean Area (in ha)	CAGR (%)	Mean Area (in ha)	CAGR (%)
Banana	784.53	3.90 **	705.40	7.72 **	811.60	8.43 **	944.13	10.56 **	4967.33	9.64 **
Total Fruits	1179.00	2.02 *	3251.67	2.91 **	1207.73	3.08 **	1950.87	4.32 **	10559.40	6.77 **
Ginger	820.93	3.17 *	959.13	12.87 **	154.40	3.91 **	736.13	4.19 **	3784.60	9.52 **
Cardamom	53.87	3.34 **	16.60	5.12	143.80	-0.02 *	96.00	2.48 **	301.80	1.62 *
Pepper	149.33	2.84 *	105.00	-3.14	356.53	0.30	205.00	3.35 **	826.53	1.40
Total Spices	3674.80	6.02 **	3951.47	5.91 **	7567.60	3.69 **	4981.60	3.48 **	42099.87	5.31 **
Arecanut	2632.33	7.23 **	2590.80	6.91 **	6838.00	4.02 **	3844.07	3.72 **	36141.60	5.55 **
Coconut	447.00	-0.30	424.73	-2.18 **	587.07	-4.31 **	608.60	-1.96 **	6395.27	-1.62 **
Coffee	21.13	4.84 **	32.87	-3.84 *	312.47	0.86	116.13	2.19	506.80	0.97
Rubber	372.93	9.52 **	361.00	8.41 **	212.87	7.21 **	414.53	7.84 **	1408.53	6.27 **
Total Vegetables	9.13	-2.87	29.07	-14.29 *	15.21	-10.29 **	16.53	-8.94 **	390.53	-5.31 **
Paddy	11521.93	-0.77 **	28662.67	-0.72 **	14985.00	-1.62 **	15529.87	-0.90 **	128650.40	-0.94 **
Total cereals	1876.53	-0.56 **	36039.80	1.26 **	14988.00	-1.62 **	17007.00	-0.13	172571.87	0.35
Total Pulses	32.47	-27.85 **	802.33	-6.80 **	183.45	-14.24 **	217.40	-18.97 **	2941.53	-7.48 **
Total Food Grains	1909.47	-0.62 **	36811.00	1.04 **	14843.67	-2.05 **	17156.93	-0.27 *	175197.40	0.17
Total Oilseeds	59.40	1.27	969.80	-15.24 **	8.60	-5.83 **	295.20	-8.43 *	3296.20	-7.32 **

Note : **&* indicates Significant at one per cent and five per cent, respectively
CAGR : Compound Annual Growth Rate

as a whole, revealed that banana (9.64%) registered the highest positive and significant growth rate followed by ginger (9.52%), total fruits (6.77%) and rubber (6.24%). The findings are in conformity with the results of Kamble and Wali (2016),

Instability indices of major crops in Hilly Zone of Karnataka (2001-02 to 2015-16)

The details on instability indices for area under major cereals, pulses, oilseeds, vegetables, spices, fruit crops and other major commercial crops of Shivamogga district for the period from 2001-02 to 2015-16 is presented in the Table IV. The estimated instability index for Hosanagara taluk revealed high degree of instability for total vegetables (48.27%) followed by total pulses (39.39%), total oilseeds (29.17%), cardamom (19.98%), ginger (18.57%) and coffee (23.50%). While competitively high degree of instability was registered for area under total vegetables (100.98%) and followed by cardamom (61.45%), total pulses (36.18%), ginger (30.02%), and coffee (28.73%) for Soraba taluk. Similarly, the instability results for Thirthahalli taluk depicted that, area under total oilseeds (87.54%) showed high degree of instability followed by total vegetables (65.21%), total pulses (56.02%), ginger (22.80%) and coffee (18.68%). With respect to Sagar taluk, the area under total oilseeds (111.32%) showed high degree of instability followed by total vegetables (79.29%), total pulses (61.06%), rubber (38.11%), ginger (23.39%) and coffee (20.65%).

For the district as whole, higher degree of instability was observed for area under total oilseed crops (27.58%) followed by ginger (26.02%), total pulses (22.24%), total fruits (19.98%), rubber (18.57%), pepper (17.69%) and total vegetables (15.54%).

TABLE IV

Instability indices of major crops in hilly zone of Karnataka (2001-02 to 2015-16)

Crops	Shivamogga District				Shivamogga District
	Hosanagara	Soraba	Thirthalli	Sagar	
Banana	18.15	14.44	16.27	9.70	8.04
Total Fruits	15.35	11.48	10.17	4.44	19.98
Ginger	28.54	30.02	22.80	23.39	26.02
Cardamom	29.04	61.45	18.13	14.60	12.87
Pepper	21.59	30.39	20.08	10.71	17.69
Total Spices	10.10	9.34	4.56	5.04	3.49
Arecanut	8.64	5.12	5.70	4.35	2.85
Coconut	7.04	6.91	9.44	3.74	4.76
Coffee	23.50	28.73	18.68	20.65	12.82
Rubber	13.58	26.44	10.11	38.11	18.57
Total Vegetables	48.27	100.98	65.21	79.29	15.45
Paddy	2.05	2.16	1.43	1.70	5.38
Total cereals	1.83	3.80	1.42	2.19	2.96
Total Pulses	39.39	36.18	56.02	61.06	22.24
Total Food Grains	1.88	3.33	4.13	2.13	2.88
Total Oilseeds	29.17	26.39	87.54	111.32	27.58

Crop Diversification in Hilly Zone of Karnataka (2001-02 to 2015-16)

The pattern of crop diversification in Hilly Zone of Shivamogga district was captured by using Herfindal, Simpson and Composite entropy Index for the period from 2001-02 to 2015-16 and results are presented in the Table V. The results form composite entropy index revealed that, among four selected taluks of Shivamogga district, Soraba registered the high percentage of crops diversification (66%) followed by Sagar (63%), Thirthahalli (57%) and Hosanagar (54%). Similarly, the results from Simpson index showed that, Soraba showed the higher degree of crops diversification (61%) followed by Sagar (64%), Thirthahalli (56%) and Hosanagar (52%) taluks of Shivamogga district. These findings are in confirmatory with the results of Ramappa *et al.*, (2015).

TABLE V

Crop diversification in hilly zone of Karnataka (2001-02 to 2015-16)

Diversification Index	Herfindal Index	Simpson Index	Composite Entropy Index
Hosanagara	0.48	0.52	0.54
Soraba	0.36	0.64	0.66
Thirthahalli	0.44	0.56	0.57
Sagar	0.39	0.61	0.63
Shivamogga Dist.	0.33	0.67	0.69

The trends in area, production and yield of banana for two study periods *viz., Period-I* (1995-96 to 2004-05) and Period-II (2005-06 to 2014-15) for Karnataka and India were analysed using growth and instability indices. The bifurcation of study period was purposefully made to capture the impact of National Horticulture Mission (2005-06) on growth performance of area, production and productivity of banana. The study revealed that the area, production and productivity of banana both in India and Karnataka during the period from 2005-06 to 2014-15 showed significant growth rates compared to Period-I (1995-96 to 2004-05). The significant growth rates in area, production and productivity in banana during Period-II was synchronized with introduction of NHM during 2005-06 by Government of India. The NHM contributed for the significant increase in area, production and productivity of banana in India and Karnataka. The results on shift in cropping pattern in Hilly Zone of Karnataka for the period from 2001-02 to 2015-16 revealed that, majority of horticulture crops exhibited positive trend compared to agricultural crops. Thus, farmers in the Zone shifted crop area from traditionally grown, less remunerative crop to more remunerative horticultural crops.

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